

# **Quarterly Progress Report #3**

For the project entitled:

## **Comparative Analysis of Coarse Surfacing Aggregate Using Micro-Deval, L.A. Abrasion and Sulfate Soundness Tests**

*Reporting Period: April 1 – June 30, 2006  
(Fourth Quarter of State Fiscal Year 2006)*

Submitted by:

**Eli Cuelho, P.E.**  
Research Engineer  
Western Transportation Institute (WTI)  
College of Engineering  
Montana State University – Bozeman

**Robert L. Mokwa, Ph.D., P.E.**  
Assistant Professor  
Department of Civil Engineering  
College of Engineering  
Montana State University – Bozeman

Submitted to:

**Montana Department of Transportation**  
Research Programs  
2701 Prospect Avenue  
Helena, Montana 59620

August 30, 2006

**Task 0: Project Management**

During this quarter, Eli Cuelho and Bob Mokwa oversaw the various tasks associated with the project through frequent meetings with one another and the two undergraduate students involved with the project (Keely Obert and recently hired James Robinson). A teleconference was held on June 19<sup>th</sup> to discuss specific project questions and to update the technical panel on the progress of the project.

Based on our request, the project completion date was extended by three months to December 12, 2006, with no change in the project budget. The project is on schedule to meet this revised completion date.

**Task 1: Conduct Literature Review**

The vast majority of the literature relevant to this project was collected during this quarter. A written summary of this literature, which is mostly complete, will be included in the final report.

Action Items for next quarter:

- Finish collecting and synthesizing literature

**Task 2: Materials Testing**

A change in undergraduate testing personnel occurred during this period. While training a new student for the project, it was observed that the previous student (who originally began work on the project in the MDT Helena lab) had made a minor deviation from the standard L.A. Abrasion test procedures. Because the deviation was minor, it was physically difficult to detect, and consequently it was not observed in time by the principal investigators. Unfortunately, the testing error influenced the numeric results of the majority of tests conducted by this student at the MSU lab. (It has not been confirmed if the student made a similar error while previously conducting tests at the MDT lab.) The mistake involved an incorrect placement of a catch pan beneath the ball mill drum. The rectangular-shaped catch pan inadvertently was oriented 90 deg from the proper direction. Because of the incorrect orientation of the pan, a small quantity of material was not captured at the end of each test. The amount of material missed by the pan varied from test to test. Consequently, after considerable study, we have determined that it is not possible to correct or adjust the previous tests results with any degree of certainty.

This issue with the L.A. Abrasion tests was discussed during a teleconference conducted on June 19 between the MSU project team and members of the MDT technical panel. Participants of the teleconference agreed that the questionable L.A. Abrasion test results should be discarded and replaced with available data that was previously produced by MDT laboratories.

The MDT L.A. Abrasion test data was transmitted to the project team, and will be included in the analysis. Table 1 summarizes the tests conducted on this project to date. In some cases,

the L.A. Abrasion test results represent a compilation of both MDT and MSU data. Note that for some samples, only three L.A. Abrasion test results are available. We believe this number of tests will be sufficient to draw general conclusions, based on the standard deviations we have observed in the L.A. Abrasion tests. The Micro-Deval testing phase of the project will be complete as soon as we receive additional material that was requested for sample No. 864947.

In summary, results from 98 Micro-Deval, 131 L.A. Abrasion, and 19 Sulfate Soundness tests have been processed. Additional L.A. Abrasion test results provided by MDT were used to augment the analysis.

Action Items for Next Quarter:

- Finish Micro-Deval testing (after receiving additional material from MDT for sample No. 864947).

**TABLE 1. Summary of Laboratory Test Results**

Soil	Micro-Deval			L.A. Abrasion			NaSO <sub>4</sub>
	Average	St. Dev.	N	Average	St. Dev.	N	
861553	2.1	0.6	5	17.0	2.7	3	1.0
861554	3.9	0.2	5	16.3	1.0	7	0.0
861555	5.7	0.2	5	20.5	0.6	4	0.0
861556	16.5	1.1	5	34.4	0.5	5	4.0
861557	15.8	1.5	5	36.7	1.2	3	8.0
861678	40.3	0.9	5	45.2	0.4	5	1.0
861871	6.0	0.6	5	22.0	2.8	10	1.0
861872*	13.7	0.7	5				11.0
863381	7.4	0.5	5	19.6	0.9	11	1.0
863382	17.5	1.6	5	28.4	1.3	6	6.0
863383	6.6	0.4	5	11.9	1.3	8	1.0
863384	23.4	0.5	5	36.3	0.6	3	16.0
864332	36.4	2.1	5	34.2	2.4	5	14.0
864941	5.7	0.2	5	22.3	1.2	15	0.0
864944	21.3	0.6	5	28.4	0.7	4	6.0
864945	6.0	0.9	5	20.5	1.9	13	3.0
864946	41.0	0.5	5	36.0	2.7	8	38.0
864947	32.1	1.0	3	35.5	1.7	11	24.0
865006	11.4	0.6	5	29.6	7.0	6	2.0
865937	16.4	1.4	5	24.0	0.8	4	

\* same pit as #861871, but do not have L.A. values

N = number of tests

**Task 3: Analysis and Synthesis of Results**

Data from the tests have been stored in an electronic database. We are currently in the process of evaluating data to quantify potential variations in results between the three degradation tests examined in this study. Results from the study will be published in the final report next quarter.

Action Items for Next Quarter:

- Finalize analysis of test results

**Task 4: Reporting****Final Report**

Work on the final report is well underway and a draft will be sent to MDT for review next quarter.

**Summary of Expenditures**

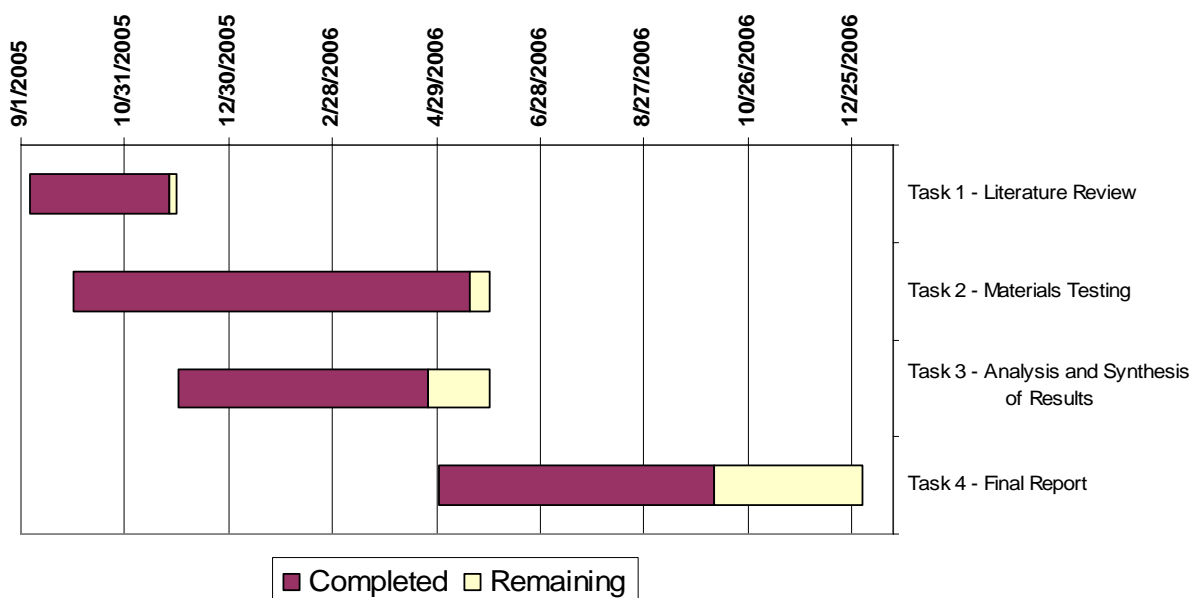
Table 2 summarizes the expenditures on this project through June 30, 2006. Expenditures during the fourth quarter were \$11,503, leaving \$6,828 for the remainder of the project.

**TABLE 2. Summary of Expenditures**

<b>Budget Category</b>	<b>Budgeted Funds</b>	<b>Spent This Period</b>	<b>Total Spent</b>	<b>Total Remaining</b>
Salaries	\$11,445.00	\$7,397.18	\$8,269.63	\$3,175.37
Benefits	\$3,323.00	\$1,503.62	\$1,783.86	\$1,539.14
In-State Travel	\$150.00	\$0.00	\$0.00	\$150.00
Out-of-State Travel	\$0.00	\$0.00	\$0.00	\$0.00
Expendable Supplies	\$150.00	\$29.84	\$29.84	\$120.16
Tuition	\$0.00	\$0.00	\$0.00	\$0.00
Subcontracts	\$0.00	\$0.00	\$0.00	\$0.00
MDT Direct Costs	\$15,068.00	\$8,930.64	\$10,083.33	\$4,984.67
Overhead	\$3,014.00	\$1,786.12	\$2,016.65	\$997.35
MDT Share	\$18,082.00	\$10,716.76	\$12,099.98	\$5,982.02
WTI/MSU Share (Salaries & Benefits)	\$5,242.00	\$786.45	\$4,395.72	\$846.28
<b>Total</b>	<b>\$23,324.00</b>	<b>\$11,503.21</b>	<b>\$16,495.70</b>	<b>\$6,828.30</b>

### Project Schedule Summary

An updated summary of the project status is shown in Figure 1. The schedule in the figure was updated to reflect the new project end date of December 31, 2006. The majority of remaining work falls under Task 4, Final Report. A final draft report is scheduled to be complete for submittal to MDT by mid September. The remaining time in this task is for review by MDT and subsequent modification by the project team.



**FIGURE 1. Project schedule and status by task.**